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☐ 1. Document ID: US 6565763 B1

L13: Entry 1 of 13

File: USPT

May 20, 2003

US-PAT-NO: 6565763

DOCUMENT-IDENTIFIER: US 6565763 B1

TITLE: Method for manufacturing porous structure and method for forming pattern

DATE-ISSUED: May 20, 2003

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Asakawa; Koji	Kawasaki			JP
Hiraoka; Toshiro	Yokohama			JP
Asakawa; Yoshihiro	Kawasaki			JP
Hotta; Yasuyuki	Funabashi			JP

US-CL-CURRENT: 216/56; 216/22; 216/24; 216/40; 216/41; 216/67; 521/61

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	MMIC	Draw D
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☐ 2. Document ID: US 6525105 B1

L13: Entry 2 of 13

File: USPT

Feb 25, 2003

US-PAT-NO: 6525105

DOCUMENT-IDENTIFIER: US 6525105 B1

TITLE: METHODS OF SEPARATING VULCANIZED OR UNVULCANIZED RUBBER AND SEPARATING RUBBER COMPOSITE, RUBBER COMPOSITION CONTAINING RECOVERED RUBBER OR RECOVERED CARBON BLACK, AND PROCESS FOR PRODUCING CARBON BLACK

DATE-ISSUED: February 25, 2003

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Udagawa; Yoshitaka	Kanagawa			JP
Ashizawa; Susumu	Kanagawa			JP

US-CL-CURRENT: 521/41; 423/449.2

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	RWC	Draw D
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☐ 3. Document ID: US 6514394 B1

L13: Entry 3 of 13

File: USPT

Feb 4, 2003

US-PAT-NO: 6514394

DOCUMENT-IDENTIFIER: US 6514394 B1

TITLE: Sensor for application in molten metals

DATE-ISSUED: February 4, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Vangrunderbeek; Johan	Zemst			BE
Lens; Pieter	Arendonk			BE
Luyten; Jan	Vaalbeek			BE

US-CL-CURRENT: 204/400; 204/422, 205/775, 205/790

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	RWC	Draw D
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☐ 4. Document ID: US 5549667 A

L13: Entry 4 of 13

File: USPT

Aug 27, 1996

US-PAT-NO: 5549667

DOCUMENT-IDENTIFIER: US 5549667 A

TITLE: Mechanical heart with wear resistant coatings of reduced thrombogenicity

DATE-ISSUED: August 27, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Davidson; James A.	Germantown	TN		

US-CL-CURRENT: 623/3.29

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	RWC	Draw D
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☐ 5. Document ID: US 5360680 A

L13: Entry 5 of 13

File: USPT

Nov 1, 1994

US-PAT-NO: 5360680

DOCUMENT-IDENTIFIER: US 5360680 A

TITLE: Mechanically rechargeable electric batteries and anodes for use therein

DATE-ISSUED: November 1, 1994

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Goldman; Arnold J.	Jerusalem			IL
Pecherer; Eugeniy	Netanya			IL
Goldstein; Jonathan R.	Jerusalem			IL
Biran; Joseph	Raanana			IL
Korall; Menachem	Jerusalem			IL
Meitav; Arye	Rishon Le'Zion			IL

US-CL-CURRENT: 429/27; 429/17, 429/19, 429/34

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	MAC	Draw D
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## 6. Document ID: US 5288384 A

L13: Entry 6 of 13

File: USPT

Feb 22, 1994

US-PAT-NO: 5288384

DOCUMENT-IDENTIFIER: US 5288384 A

TITLE: Wetting of diaphragms

DATE-ISSUED: February 22, 1994

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Banerjee; Shoibal	Newark	DE		

US-CL-CURRENT: 204/252; 204/296, 427/243, 427/337, 521/27

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	MAC	Draw D
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## 7. Document ID: US 5282850 A

L13: Entry 7 of 13

File: USPT

Feb 1, 1994

US-PAT-NO: 5282850

DOCUMENT-IDENTIFIER: US 5282850 A

TITLE: Artificial heart components with wear resistant coatings of reduced thrombogenicity

DATE-ISSUED: February 1, 1994

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
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Davidson; James A.                      Germantown                      TN

US-CL-CURRENT: 623/3.29; 427/2.24

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	INAC	Draw	Doc
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☐ 8. Document ID: US 5183545 A

L13: Entry 8 of 13

File: USPT

Feb 2, 1993

US-PAT-NO: 5183545

DOCUMENT-IDENTIFIER: US 5183545 A

TITLE: Electrolytic cell with composite, porous diaphragm

DATE-ISSUED: February 2, 1993

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Branca; Phillip A.	Newark	DE	19711	
Hubis; Daniel E.	Elkton	MD	21921	
Mallouk; Robert S.	Chadds Ford	PA	19317	
Perry; Randal L.	Wilmington	DE	19810	

US-CL-CURRENT: 204/252; 204/296

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	INAC	Draw	Doc
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☐ 9. Document ID: US 5132171 A

L13: Entry 9 of 13

File: USPT

Jul 21, 1992

US-PAT-NO: 5132171

DOCUMENT-IDENTIFIER: US 5132171 A

**\*\* See image for Certificate of Correction \*\***

TITLE: Non-flammable open-cell cross-linked polyolefin foam and method for production thereof

DATE-ISSUED: July 21, 1992

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Yoshizawa; Iwao	Tsuzuki			JP
Shibata; Tomoyoshi	Uji			JP
Kaji; Kanako	Osaka			JP
Hatada; Motoyoshi	Neyagawa			JP

US-CL-CURRENT: 428/317.1; 427/207.1, 427/243, 427/244, 428/317.3, 428/317.7,  
428/317.9, 428/323, 428/343, 428/355AC, 428/355EN, 428/355N, 428/921

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	MAC	Draw D
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☐ 10. Document ID: US 5094895 A

L13: Entry 10 of 13

File: USPT

Mar 10, 1992

US-PAT-NO: 5094895

DOCUMENT-IDENTIFIER: US 5094895 A

TITLE: Composite, porous diaphragm

DATE-ISSUED: March 10, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Branca; Phillip A.	Newark	DE	19711	
Habis; Daniel E.	Elkton	MD	21921	
Mallouk; Robert S.	Chadds Ford	PA	19317	
Perry; Randal L.	Wilmington	DE	19810	

US-CL-CURRENT: 428/36.91; 428/220, 428/308.4, 428/422

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	MAC	Draw D
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L13: Entry 1 of 13

File: USPT

May 20, 2003

DOCUMENT-IDENTIFIER: US 6565763 B1

TITLE: Method for manufacturing porous structure and method for forming pattern

Brief Summary Text (27):

An electrochemical cell of the present invention comprises a pair of electrodes and a separator interposed between the electrodes and impregnated with an electrolyte, wherein the separator is constituted by a porous structure formed by selectively removing a polymer phase from a block copolymer or graft copolymer having a structure having micro polymer phases.

Detailed Description Text (176):

Next, application of the porous structure of the present invention to an electrochemical cell such as a lithium ion secondary battery or an electrochromic device will be described. FIG. 5 shows a conceptual diagram of an electrochemical cell. The electrochemical cell has a structure in which provided are the positive electrode 71 and the negative electrode 72, each of which is provided with a collector, and the separator 73 impregnated with an electrolyte and interposed between the electrodes.

Detailed Description Text (177):

In the electrochemical cell of the present invention, used as the separator 73, for example, is a porous structure formed by removing one polymer phase selectively from a block copolymer having a structure having micro polymer phases. The separator can be manufactured by using a pattern forming material comprising a block copolymer having, for example, a polymer chain decomposable by irradiation with an energy beam and an indecomposable polymer chain, as described below. First, a sheet of a pattern forming material is formed, followed by allowing the sheet to form a structure having micro polymer phases. The sheet is irradiated with an energy beam to decompose the main chain of one polymer phase. Next, the sheet is placed between the negative electrode and the positive electrode via a roll-to-roll process, and then they are hot-pressed. The laminate of pressed electrodes and separator is rinsed with a solvent to remove the polymer phase whose main chain has been decomposed, thereby making the separator sheet porous. Here, the polymer phase whose main chain has been decomposed may be evaporated and removed by reducing pressure or heating. After being sufficiently dried, the laminate is immersed in a bath of an electrolytic solution containing a supporting electrolyte, etc., thereby allowing the laminate to be impregnated with the electrolytic solution. Lead wires, etc., are connected to the resultant laminate, followed by sealing the laminate with an aluminum laminate film, for example, thus manufacturing an electrochemical cell.

Detailed Description Text (182):

The electrolyte solution to be impregnated into the separator may be one that an inorganic salt or organic salt is dissolved in water or a polar solvent, or may be a room-temperature molten-salt. In the case of a lithium ion secondary battery, an electrolyte solution that a lithium salt is dissolved in a polar solvent or in room-temperature molten-salt is employed. As the lithium salt, employed is LiPF<sub>6</sub>.sub.6, LiBF<sub>4</sub>.sub.4, LiClO<sub>4</sub>.sub.4, LiSCN, Li.sub.2 B.sub.10 Cl.sub.10, LiCF<sub>3</sub>.sub.3 CO.sub.2, lithium triflate, or the like. As the polar solvent, employed is a carbonate-based solvent such as ethylene carbonate, propylene carbonate and diethyl

carbonate; a lactone-based solvent such as  $\gamma$ -butyrolactone; sulfolane-based solvent such as sulfolane and 3-methylsulfolane; and ether-based solvent such as 1,2-dimethoxyethane and methyl diglyme. As the room temperature molten-salt, employed is an imidazolium salt such as 1-methyl-3-ethylimidazolium triflate and a pyridinium salt such as N-butylpyridinium triflate.

Detailed Description Text (215):

The filter of the present invention can be suitably used as a filtration membrane, a dialysis membrane, a gas separation membrane, a reverse osmosis membrane, an ultrafiltration membrane, a microfiltration membrane or a blood purification membrane. In most of these applications, the filter is used in the form of filter module.

Detailed Description Text (302):

The porous film is impregnated with a 1M solution of  $\text{LiClO}_4$ .sub.4 (anhydride) in propylene carbonate and punched out into a disk having a diameter of 0.5 cm to provide an electrolyte-impregnated porous film having a thickness of about 50  $\mu\text{m}$ . The electrolyte-impregnated porous film is sandwiched between platinum electrodes to give a cell, which is measured for AC impedance using an impedance gain phase analyzer 1260 (Schlumberger Instruments Co., Ltd.) at room temperature and at a frequency of 30 MHz to 0.05 Hz. Thus, ion conductivity of the cell is determined from  $\sigma = (1/R) (d/s)$ , where R is electric resistance of the film given by the measured AC impedance; s ( $\text{cm}^2$ ) is the area of the film; and d (cm) is the thickness of the film. The porous film exhibits good ion conductivity of 4.2  $\text{mScm} \cdot \text{sup} \cdot \text{l}$  at 25.degree. C. The porous film holds the electrolyte solution well, and hence, no liquid leakage occurs.

Detailed Description Text (303):

Further, an electrolyte-impregnated porous film is prepared in the same manner as described above except that 3 wt %, based on the diblock copolymer, of silica fine particles (Tokuseal P, Tokuyama Soda Co., Ltd.) is dispersed in the solution of diblock copolymer. The resultant porous film exhibits good ion conductivity of 4.5  $\text{mScm} \cdot \text{sup} \cdot \text{l}$  at 25.degree. C.

Detailed Description Text (304):

It is found from these results that the electrolyte-impregnated porous film in this example has an excellent property useful for an electrolyte separator for an electrochemical cell such as a lithium ion secondary battery, and for a dye-sensitizing photovoltaic cell such as an electrochromic cell and a Gratzel cell.

Detailed Description Text (308):

The porous sheet is impregnated with a 1M solution of  $\text{LiClO}_4$ .sub.4 (anhydride) in propylene carbonate, and then punched out in to a disk having a diameter of 0.5 cm to provide an electrolyte-impregnated porous sheet having a thickness of about 50  $\mu\text{m}$ . When the electrolyte-impregnated porous sheet is measured for ion conductivity in the same manner as in Example 16, it exhibits good ion conductivity of 4.6  $\text{mScm} \cdot \text{sup} \cdot \text{l}$ .

Detailed Description Text (312):

The porous film is impregnated with a 1M solution of  $\text{LiClO}_4$ .sub.4 (anhydride) in propylene carbonate, and the punched out into a disk having a diameter of 0.5 cm to provide an electrolyte-impregnated porous sheet having a thickness of about 50  $\mu\text{m}$ . When the electrolyte-impregnated porous sheet is measured for ion conductivity in the same manner as in Example 16, it exhibits good ion conductivity of 4.1  $\text{mScm} \cdot \text{sup} \cdot \text{l}$ .

Detailed Description Text (360):

$\text{LiClO}_4$ .sub.4 anhydride is dissolved in a mixed solvent of propylene carbonate and dimethyl carbonate (1:1) to prepare a 1M concentration of electrolyte solution. The porous film having a thickness of about 50  $\mu\text{m}$  obtained as above is impregnated

with the electrolyte solution, and the film is punched out into a disk having a diameter of 0.5 cm. The electrolyte-impregnated porous film is sandwiched between a pair of platinum electrodes to constitute a cell, which is measured for AC impedance using an impedance gain phase analyzer 1260 (Schlumberger Instruments Co., Ltd.) at room temperature and at a frequency of 30 MHz to 0.05 Hz. As a result, the film exhibits good ion conductivity of  $4 \text{ mScm}^{-1}$  at 25.degree. C. In addition, the porous film holds the electrolyte solution well, and hence, no liquid leakage occurs.

#### Detailed Description Text (364):

The aforementioned diblock copolymer is dissolved in a solvent, to which silica (Tokuseal P, Tokuyama Soda Co., Ltd.) is added 3 wt % based on the diblock copolymer. The solution is cast to form a cast film of the diblock copolymer. The positive electrode, the negative electrode and the cast film are respectively heat-treated under a nitrogen flow at 130.degree. C. for 5 hours, and then they are irradiated with electron beam under the conditions of 2 MV in accelerating voltage and 10 Kgy in exposure dose. The positive electrode, the cast film and the negative electrode are laminated in the order, followed by pressing with a hot press, to manufacture a laminate. The laminate is rinsed with ethyl acetate to remove the polymethacrylate phase in the diblock polymer. The laminate is heated under vacuum at 70.degree. C. for 20 hours so as to be dried, thereby manufacturing a cell structure. LiPF<sub>6</sub>.sub.6 anhydride is dissolved in a mixed solvent of propylene carbonate and dimethyl carbonate (1:1) to prepare a 1M concentration of electrolyte solution. The cell structure is immersed in the electrolyte solution to be impregnated with the electrolyte solution. The resultant cell structure is wrapped with waterproof and airtight aluminum laminate film and sealed under an argon flow. External electrode terminals are connected the negative and positive electrodes, respectively, thereby manufacturing a lithium ion secondary battery.

#### Detailed Description Text (399):

Then, the aluminum deposited film formed on the surface is removed by immersing the substrate in an aqueous solution of hydrochloric acid, and then the substrate is irradiated with an electron beam. After electron beam irradiation, the cast film is rinsed with a mixed solution of MIBK and IPA in 3:7 by volume ratio, thereby making the polymer film porous. Observation of the porous polymer film with an electron microscope shows that holes, which reach the gold film, having a diameter of 10 nm are formed perpendicular to the substrate. The porous film is subjected to potentiostatic electrolysis in a gold plating bath to deposit gold in the through-holes. When the porous polymer layer is removed by ashing with oxygen after electroforming, provided is a structure in which many gold fibers having a diameter of about 8 nm are arranged on the gold film with perpendicularly oriented to the substrate like a pinholder. Likewise, when Iridium is subjected to electroforming, it is possible to provide a pinholder structure similar to that in the case of gold.

#### Detailed Description Text (405):

Thereafter, the aluminum deposition film formed on the surface is removed by immersing the sample in an aqueous solution of hydrochloric acid, and then the sample is irradiated with an electron beam. After the electron beam irradiation, the cast film is rinsed in a 3:7 mixed solution of MIBK and IPA to make the polymer film porous. When the porous polymer film is observed with an electron microscope, it is found that holes having a diameter of 120 nm, which reach the gold film, are formed perpendicular to the substrate. The porous film is subjected to potentiostatic electrolysis in a nitrogen-purged B<sub>2</sub>.sup.3+ /H<sub>2</sub>O<sub>2</sub>.sup.2+ bath using a platinum mesh as a counter electrode, thereby depositing bismuth telluride in the through-holes. When the porous polymer layer is removed after the electroforming, it is possible to obtain a structure in which many bismuth telluride fibers having a diameter similar to that of the cylinder and oriented perpendicular to the substrate are formed on the gold film like a pinholder. The bismuth telluride fiber can be employed for a high-efficiency thermoelectric conversion element.



Detailed Description Text (413):

The resultant porous sheet is subjected to repeating processes comprising steps of being impregnated with a poly(2-bromoethyl) silsesquioxane, being irradiated with an ultraviolet ray, and being heat-treated at 80.degree. C., by five times, and thus poly(2-bromoethyl)silsesquioxane is sufficiently loaded into pores of the porous sheet. The porous sheet is subjected to heat-treatment in a nitrogen gas flow at 150.degree. C. for one hour and at 450.degree. C. for one hour. As a result, manufactured is a silica porous body having a nanostructure that is transferred using the porous structure of the porous sheet as a template.

Detailed Description Text (414):

A mixed solution of acrylonitrile mixed with 10 wt % of 3,3',4,4'-tetra(t-butylperoxycarbonyl) benzophenone is prepared. The silica porous body is impregnated with the solution. The silica porous body is irradiated with an ultraviolet ray, thereby polymerizing and curing the acrylonitrile. The structure is heated in air at 210.degree. C. for 24 hours, and then heated in a nitrogen gas flow from 210.degree. C. to 800.degree. C. at a rate of temperature rise of 10.degree. C. per minute so as to be carbonized. The composite of silica and carbon is treated with hydrofluoric acid to solve out the silica. As a result, it is possible to manufacture porous carbon having continuous pores reflecting the morphology of the 1,2-polybutadiene porous sheet.

Detailed Description Text (530):

The resultant polyimide porous sheet is subjected to repeating processes comprising steps of being impregnated with a poly(2-bromoethyl)silsesquioxane, being irradiated with an ultraviolet ray, and being heat-treated at 80.degree. C., by five times, and thus poly(2-bromoethyl)silsesquioxane is sufficiently loaded into pores of the porous sheet. The porous sheet is subjected to oxygen ashing under the conditions of 800 W and 1 Torr. As a result, it is possible to manufacture a silica porous body having a nanostructure that is transferred using the porous structure of the polyimide porous sheet as a template.

Detailed Description Text (531):

A mixed solution of acrylonitrile mixed with 10 wt % of 3,3',4,4'-tetra(t-butylperoxycarbonyl) benzophenone is prepared. The silica porous body is impregnated with the solution. The silica porous body is irradiated with an ultraviolet ray, thereby polymerizing and curing the acrylonitrile. The structure is heated in air at 210.degree. C. for 24 hours, and then heated in a nitrogen flow from 210.degree. C. to 800.degree. C. at a rate of temperature rise of 10.degree. C. per minute so as to be carbonized. The composite of silica and carbon is treated with hydrofluoric acid to solve out the silica. As a result, it is possible to manufacture porous carbon having continuous pores reflecting the morphology of the polyimide porous sheet.